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Dredging Research

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Florida Inland Navigation District's long-range dredged material management program found successful

In 1986, the Florida Inland Navigation District (FIND) began a 15-year Long-Range Dredged Material Management Program to address long-term maintenance of the Intracoastal Waterway (ICWW) on the east coast of Florida. A central theme of the program focuses on dredging's environmental impacts, both positive and negative.

Planning for dredged material management

Separate long-range dredged material management plans were developed within FIND. Much of the material shoaling within FIND's channels is introduced through inlets to the Atlantic Ocean from the littoral system and therefore is beach compatible. As such, beach placement, where practical, became a primary dredged material handling strategy.

Upland containment facilities handle material in reaches where beach placement is impractical; store any non-beach quality material; and act as staging and temporary storage areas in reaches where beach placement is the primary handling strategy. In addition, recent plans under development in highly urbanized Dade and Broward Counties include provisions for small upland sites that act as barge off-loading facilities to truck material to inland storage facilities far from the waterway.

Phase I

There are two phases of investigations which FIND undertakes before implementing a new management plan for an area. Phase I studies proceed along two tracks: (1) developing a property assessment of currently owned FIND lands and other potential candidate sites, and (2) projecting dredging requirements over the program's 50-year design life.

Property assessment

The property assessment inventories, documents, evaluates, and ranks potential parcels that may provide adequate storage capacity or otherwise fit within plan parameters. This process produces a list of potential candidate sites for further evaluation. Next, a team consisting of a biologist and an engineer visits each candidate site to assess existing site conditions. The biological assessment characterizes on-site vegetation communities and compiles a list of prominent animal species. Suitable sites must also appear relatively free of wetlands. Sites with extensive endangered species or wetland habitats are quickly eliminated from consideration. The engineering assessment focuses on operational considerations inherent to the site and physical characteristics including total area, vehicle access, and drainage patterns. The investigators compile all site data in a database for further evaluation and eliminate sites that do not meet the plan's most basic criteria.

Dredging requirements

Parallel with the property assessment, an engineering team characterizes the current state of the waterway in regards to shoaling rates and locations as well as sediment types. A search of the USACE archives documents past dredging events within the subject county. In addition, FIND and the USACE sponsored two high quality bathymetric surveys of the entire waterway in 1996 and 2000. A custom GIS-based

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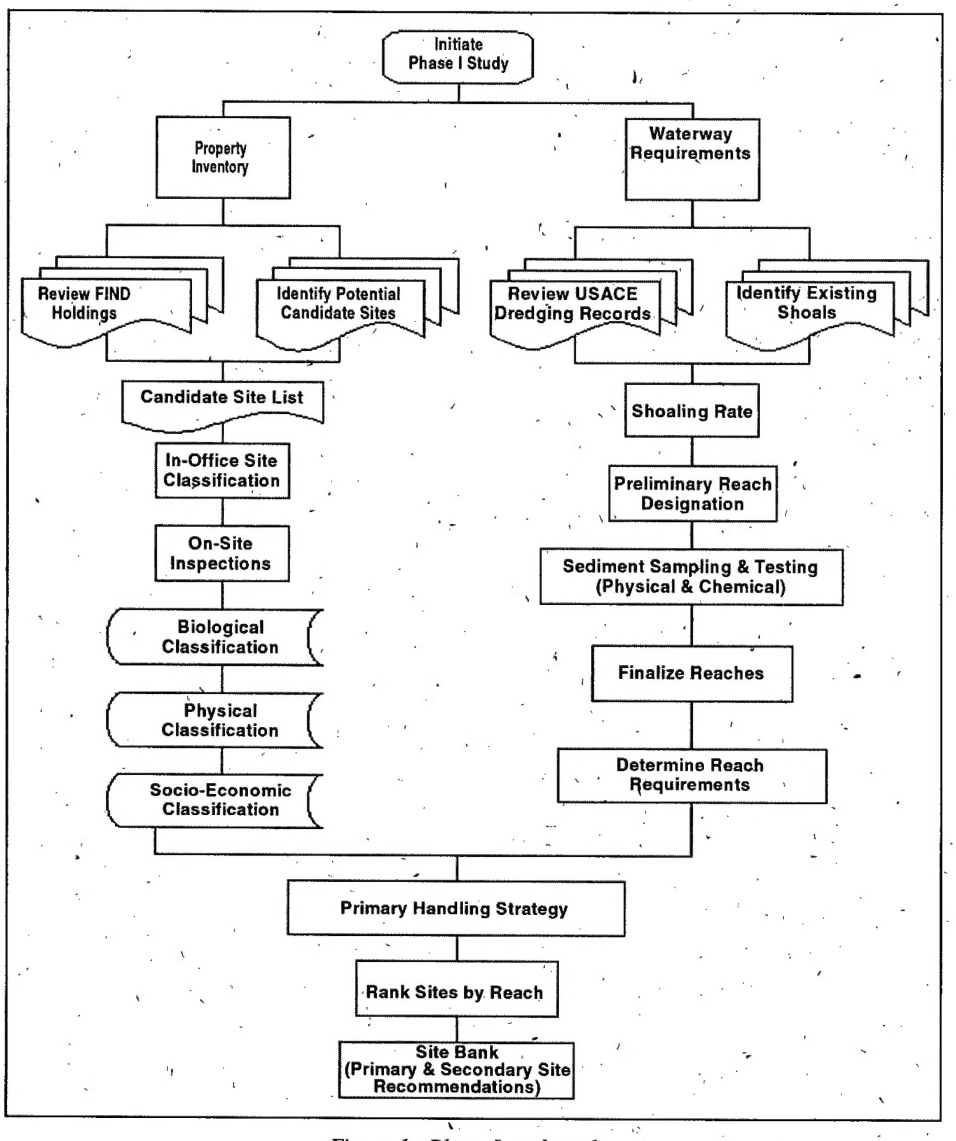


Figure 1. Phase I study tasks

software package provides a quick and easy way to examine these data and calculate shoal volumes within any part of the waterway. The combination of the two survey data sets and the historic dredging records helps determine shoaling rates within the county. These rates are projected over the 50-year design life of the program. Total volumes are bulked to account for volume increases due to mechanical handling of material.

Next, investigators segment the waterway into operational reaches. Reaches are selected based on several criteria including pumping distance, 50-year storage capacity requirements, and sediment characteristics. FIND attempts to limit operation reach length to 9.7 km (6mi). However, local conditions may warrant increasing reach lengths up to 16 km (10 mi) before pumping efficiency deteriorates. Finally, consistent with the program's goals, reach definitions maximize the amount of beach quality sand available for return to the littoral system. The number of operational reaches within a county ranges from two to seven.

Phase II

Phase II studies prepare supporting documentation for regulatory permit applications at primary sites defined for each reach. Phase II also addresses the acquisition of these sites (where necessary) either through negotiated purchase or condemnation; containment facility design; and site construction, operation, and maintenance as permanent dredged material management areas. Phase II efforts proceed along two tracks; the first determines ownership of the property, while the second further refines on-site conditions.

Property ownership

Investigators determine property ownership through title searches of local property appraiser's databases. Once ownership is determined, FIND begins the acquisition process by approaching the owners to express FIND's interest in the property. A surveyor also conducts a boundary survey of the property and performs a comprehensive topographic survey of the parcel for later site design analysis.

On-site conditions

A detailed survey examines on-site biological communities. Specifically, a biologist ground-truths the vegetation communities identified in the Phase I site visit and from aerial photography. Jurisdictional wetlands are noted and classified. Vegetation listed as federal or state protected or endangered species receive particular interest as their presence may impede permitting. The biologist also notes any wildlife communities as well as wildlife associated with existing vegetation communities, again paying particular attention to threatened or endangered species. Finally, investigators review the Florida Master File to determine any known cultural, historical, or archaeological sites on the property.

The preliminary site design considers all of the above factors when determining layout of upland containment facility dikes. Initial layout attempts to marry three competing factors: providing a sufficient buffer between the site and adjacent properties, avoiding particularly sensitive biological or cultural areas, and achieving the required storage capacity. FIND attempts to establish 91-m (300-ft) buffers; however, site

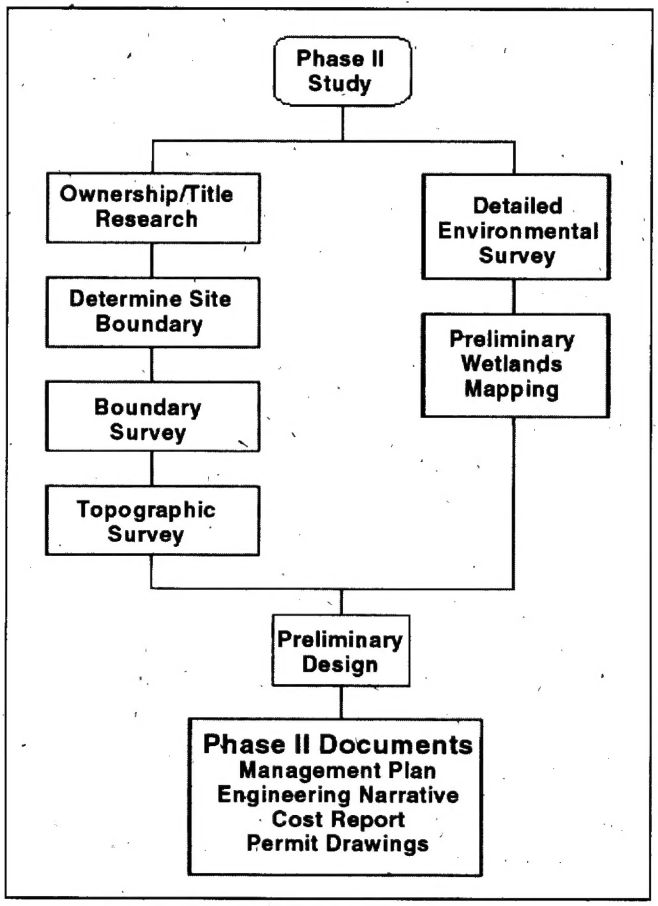


Figure 2. Phase II study tasks

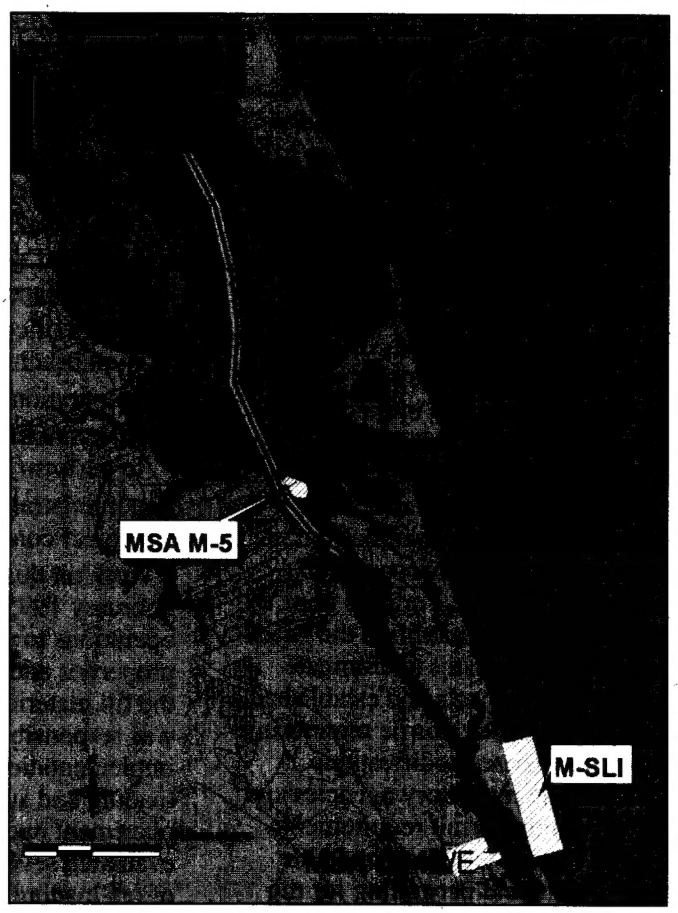


Figure 4. DMMA MSA M-5 and M-SLI in Martin County, Florida

conditions occasionally warrant a size reduction. FIND requires an absolute minimum buffer width of 15 m (50 ft) and makes every effort to leave buffer areas, typically vegetated, in their natural state.

The natural and cultural resources surveys determine areas to be avoided, if possible, during site layout. Several sites contain cultural resources such as Native American artifacts, and State policy requires either avoiding these areas or completely excavating the entire site by a state-qualified archaeologist. Other avoidance areas include wetlands, although the state allows some wetland impact depending on the balance between site layout requirements and the quality of the wetland. Any impacts to wetlands require mitigation, typically at a 3:1 ratio.

Comprehensive planning

With the layout complete, FIND prepares a comprehensive management plan and engineering narrative for the site. The management plan provides guidance for site development and operation to produce optimal effluent quality, design service life of the facility, and minimal environmental impacts to adjacent areas. The plan addresses actions necessary prior to site construction, guidelines and procedures for decanting and dewatering the dredged material during operations, and steps necessary following a dredging event to maintain the site. The engineering narrative summarizes the permit application package, and as such, provides an organizational tool for the reviewer. Finally, for budgeting purposes, a site-specific cost report is prepared which addresses expected costs for site construction, operation and maintenance.

Putting the plan in action

FIND, in collaboration with the USACE, schedules site construction based on existing dredging requirements within the ICWW. Areas with high shoaling rates receive top priority. Priority sites move to final design, permitting and construction. Both the USACE and FIND, through its engineer, have designed facilities in the past. Which entity performs this task depends on available funding. To date, eight sites have been constructed; three others are in the final design and permitting stage, with construction scheduled to follow soon.

FIND project results

An example of FIND's work lies in MSA M-5. MSA M-5 is a spoil island/dredged material management site located one mile west of St. Lucie Inlet in Martin County. It provides an example of both upland containment facility design and beach placement. MSA M-5, created from previous ICWW and inlet maintenance dredging events, could not provide any additional capacity in its existing

state. To remedy this, the final design called for off-loading the existing material and reconstructing the dikes to provide partial capacity for Reach 2 in Martin County. Given the existing sediment's demonstrated compatibility with local native beach material, the Phase I plan called for MSA M-5 to act as a temporary holding facility for material before final disposal on beach placement site M-SLI. M-SLI comprises two separate sites on Jupiter Island including one in the Hobe Sound National Wildlife Refuge.

Due to the high density of sea turtle nesting in the project area and extensive nearshore hardbottom, compliance with environmental permitting became a critical item. FIND's engineer modified the beach placement templates to eliminate hardbottom impacts and established a comprehensive sea turtle monitoring program. These modifications satisfied the regulatory agencies and all remaining permit requirements.

FIND's engineer performed the final design and permitting for the off-loading of MSA M-5 and placement on M-SLI. Tasks included:

- design and supervision of the geotechnical investigation of the stockpiled dredged material
- analysis of the resulting geotechnical data
- survey of the environmental characteristics of the proposed beach placement sites and adjacent nearshore areas
- preparation and submittal of an Environmental Resource Permit (ERP) application package
- design of the off-loading and beach placement operations
- design of construction and equilibrium beach fills
- preparation of bid documents
- selection of contractor/contractors to perform the work
- administration/inspection of project construction

Work on this project began in February 1995 with core boring operations to determine engineering properties and beach compatibility of the fill material. FIND's engineer was responsible for the design and implementation of the material off-loading and subsequent beach placement operations. The engineer evaluated several alternative methods of off-loading the material from the island, then settled on a method featuring a slurry basin (intramodal facility) adjacent to the MSA M-5's shoreline. A 0.61-m (24-in.) dredge moored between sheetpile walls immediately offshore of M-5. Earthmoving equipment fed excavated material into the intramodal facility at a sufficient rate to off-load the site efficiently. Then, from the basin, the contractor pumped the slurry to the beach sites.

Construction concluded in October 1997. Post-construction inspections showed an eroding northwest shoreline. FIND's engineers designed a rock-filled mattress (gabion) system to protect this severely eroding shoreline. In addition, the outer dike slope vegetation had difficulty establishing due to an extended drought in the area. A revised planting plan, including salt- and drought-tolerant species and increased watering provided the necessary improvement to establish the vegetation.

This article excerpted from "The Florida Inland Navigation District's Long-Range Dredged Material Management Program" by Kenneth R. Craig, P.E., Taylor Engineering, Jacksonville, FL, *kcraig@taylorengineering.com*, Allison Brewer, editor.

DOER program preparing to add new materials to "Tools" page

The Dredging Operations and Environmental Research Program website recently added a Tools page to the application (*www.wes.army.mil/el/dots/doer/tools.html*). As a first entry, video animations depicting general schematics of dredgeheads in operation under water were placed online. They are provided for educational use or for use in presentations, etc. Once at the site, to view or to download, instructions for the viewer's particular computer set-up must be followed as they apply to viewing of .avi or .mov files. The following files are online:

- Clamshell: .avi format, .mov format
- Cutter (front view): .avi format, .mov format
- Cutter (side view): .avi format, .mov format
- Dustpan: .avi format, .mov format
- Hopper: .avi format, .mov format

The Tools page will provide information on how to obtain products, and will soon add a series of calculators that will be useful to anyone working with dredging related issues. These will work in real time and will be interactive, allowing general calculations where the user provides certain values and the site returns calculated results.

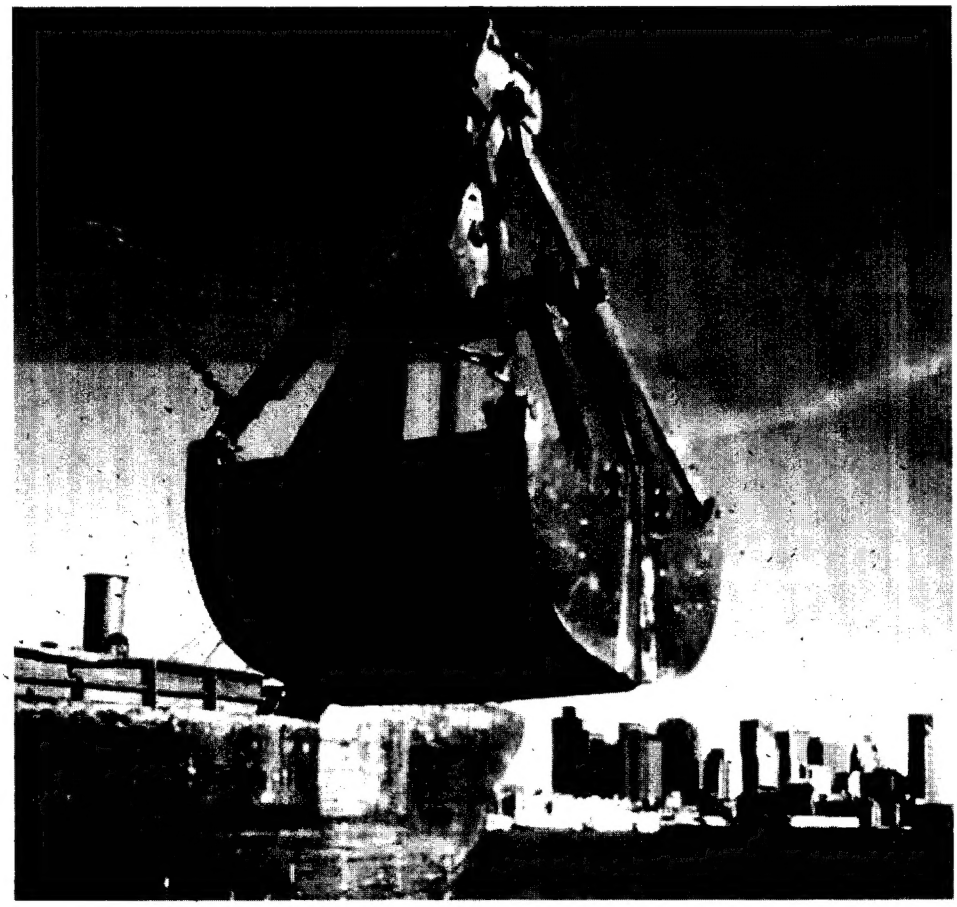
Additional information is available from Elke Briuer, APR, Technology Transfer Specialist (*Elke.Briuer@erdc.usace.army.mil*).

ERDC researchers investigate sediment resuspension and loading characteristics associated with several types of clamshell buckets

Sediment resuspension and loading characteristics of a conventional clamshell bucket, an enclosed clamshell bucket, and a cablearm clamshell bucket were studied under similar operating and environmental conditions in Boston Harbor during August 1999. Monitoring was conducted to characterize near and far field sediment resuspension and loading characteristics of these buckets.

The objective of the study was to gain a better understanding of sediment resuspension and loading characteristics generated by different types of buckets to optimize bucket selection for various dredging needs. The study also provided development/verification data for improving numerical models' ability to predict sediment resuspension.

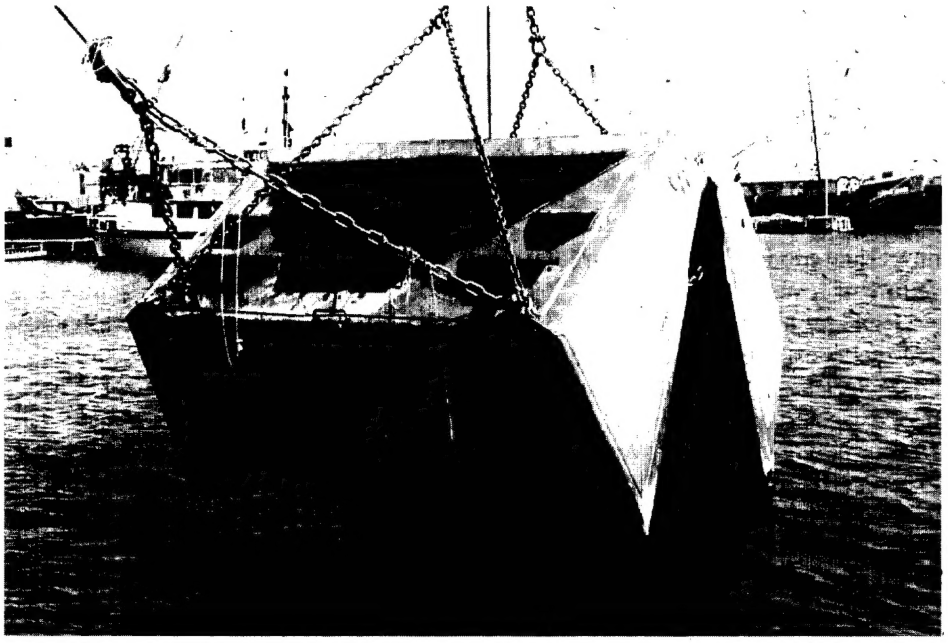
ERDC monitored near and far field sediment resuspension and loading characteristics of three different bucket designs during the Boston Harbor Navigation Improvement Project (BHNIP), which deepened tributaries to the inner harbor and associated berthing areas. Testing was conducted using a conventional (open) clamshell, a cable arm clamshell, and an enclosed clamshell. The conventional (open) clamshell is a conventional bucket with a completely open top. The cable arm clamshell has rubber side lip seals and vents (with intake seals) on either side near the top to allow water to escape during descent and after the bucket is closed. The enclosed clamshell is enclosed on the top and sides by welded steel plates and has vents on each side of the bucket near the top to allow water to escape during descent and after the bucket is closed. These buckets were all operated in similar environmental conditions at their respective optimum production rates in a navigation dredging project (compared to an environmental dredging project where the objective is to remediate a contaminated area).



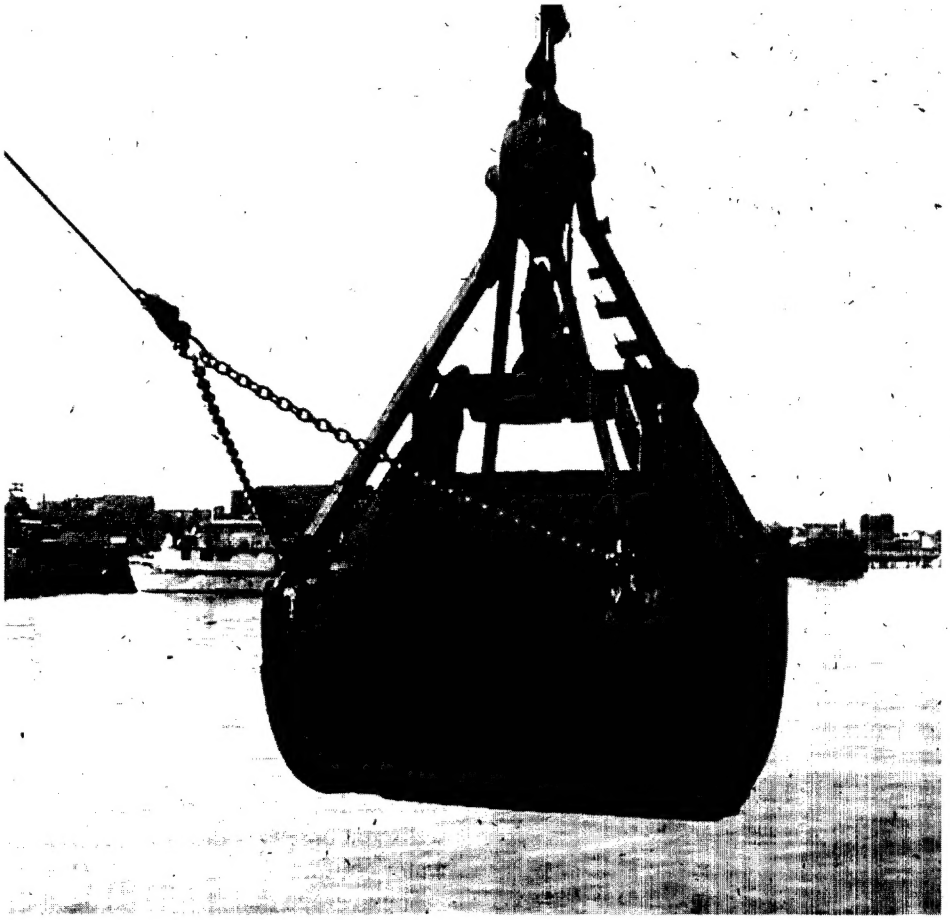
Conventional open clamshell

Sediment resuspension data consisted of suspended solids samples and turbidity measurements within 8 m (in the horizontal plane) of the bucket position (near field) and 25 to 400 m from the dredge (far field). Near field data included continuous turbidity measurements taken at four depths (1.5 m, 5.5 m, 8.0 m, and 10.5 m in a water depth of about 11.6 m) and discrete water samples analyzed for Total Suspended Solids (TSS). Far field data included indirect turbidity observations using a Broad Band Accoustic Doppler Current Profiler (BBADCP), and direct turbidity, conductivity, temperature measurements, and direct water samples for TSS analysis collected by the Battelle Ocean Survey System (BOSS). The BBADCP collected acoustic measurements of the suspended sediment plume to produce images of the relative distribution of suspended sediment concentrations in the water column.

The average densities of dredged material placed in the barges were calculated to investigate bucket loading characteristics with regard to the material's water to solids volume ratio. The dredged material weight



CableArm clamshell



Enclosed clamshell

was determined by recording the vessel's drafts and using the displacement tables to calculate hopper material weight. Its volume was determined by measuring the height of material in the hopper and using the ullage tables to calculate hopper material volume. Other data required to calculate the water to solids ratio includes the dredged material mineral and water densities. Sediment samples were collected from the hopper and analyzed to determine the mineral density, while the water density was calculated with the conductivity and temperature data collected from the BBADCP.

The study showed that the enclosed clamshell bucket had the lowest sediment resuspension ranking, the conventional clamshell bucket had the highest, and the cable arm clamshell ranked in the middle. The water to sediment volume ratio of all three buckets was approximately 4 to 1.

Additional information is available from Timothy Welp, e-mail *Timothy.L.Welp@erdc.usace.army.mil*, or on the Internet at *http://www.wes.army.mil/el/resbrief/drbucket/drbucket.html*.

DOER display part of MTS exhibition in Washington, D.C.

The Dredging Operations and Environmental Research Program's exhibit participated in the First Marine Transportation Systems (MTS) Industry Fair on June 19, 2001, on the National Mall on Capitol Hill, Washington, D.C. Beneficial use of dredged material resulting in usable soil products was featured in special exhibit cases at the event. Visitors to the booth included congressional personnel, federal workers from surrounding office buildings, and tourists. Speakers at the event were Margaret A. Davidson, Assistant Administrator for Ocean Services and Coastal Zone Management; Admiral James M. Loy, United States Coast Guard Commandant; and Charles (Chuck) G. Raymond, President and Chief Executive Officer, Sea-land, CSX Lines LLC. Raymond also serves as president of the US Department of Transportation Advisory Council.

Dredging Products

Recently published technical notes for the DOER Program are listed below. These technical notes can be found in .pdf format at *http://www.wes.army.mil/el/dots/doer/technote.html*.

- ERDC TN-DOER-C20 Implementation Guidance for the Control of Undesirable Vegetation on Dredged Material, March 2001
- ERDC TN-DOER-I6 Silent Inspector Implementation Procedures for Hopper and Pipeline Dredges, March 2001
- ERDC TN-DOER-N8 Graphical User Interface for LTFATE Version 2.0, March 2001
- ERDC TN-DOER-N9 Effects of Bentonite Clay on Sediment Erosion Rates, April 2001
- ERDC TN-DOER-N10 Erosion Rates and Bulk Properties of Dredged Sediments from Mobile, Alabama, April 2001
- ERDC TN-DOER-N11 Simulating Underflow Spreading from a Shallow-Water Pipeline Disposal, April 2001

Recently published technical notes for the EEDP program are listed below. These technical notes can be found in .pdf format at *http://www.wes.army.mil/el/dots/eedptn.html*.

- ERDC TN-EEDP-02-30 Volatile Losses from Resuspended Dredged Material, March 2001
- ERDC TN-EEDP-01-47 Annotated Bibliography and Guide to Products of the LEDO Bioaccumulation and Adverse Effects Work Unit, May 2001

Dredging Calendar

2001

Jun 24-27 - XXI Western Dredging Association (WEDA) Conference; Texas A&M University's 33rd Annual Dredging Seminar; and PIANC Session - Houston, Texas.
POC: 360-750-0209 or *www.wesda.org*

Jul 15-19 - Coastal Zone 2001, Cleveland, Ohio.
POC: *www.csc.noaa.gov/cz2001*

Aug 22-24 - Gulf Intercoastal Canal Association Convention, New Orleans, LA.
POC: *www.gicaonline.com*

Sep 17-19 - National Ground Water Association, Natural Attenuation for Remediation of Contaminated Sites, Atlanta, GA.
POC: *www.ngwa.org*

Sep 20-21 - National Ground Water Association, Water Wells: Biofouling and Public Health Risks, Atlanta, GA.
POC: *www.ngwa.org*

Sep 25-27 - 11th Southern States Annual Environmental Conference and Exhibition, Biloxi, MS.
POC: *http://www.che.msstate.edu/misstap*

Oct 1-5 - AAPA 2001 Annual Convention, Quebec City, Canada.
POC: *www.aapa-ports.org/conventions.html*

Oct 10-12 - International Conference on Remediation of Contaminated Sediments; Venice, Italy.
POC: *sedimentscon@battelle.org*

Oct 11-12 - WEDA and AMIP, III International Congress Ports and Coasts, Challenges of the 21st Century; Vera Cruz, Mexico.
POC: *http://jaws.tamu.edu@oecds/weda.html*

Oct 22-26 - Convention on the Prevention of Marine Pollution from the Dumping of Water and Other Matter, London convention of 1972, London, UK (for Convention Members only)

2002

Feb 23-27 - Water Environment Federation, Watershed 2002, Fort Lauderdale, FL.
POC: *www.wef.org*

May 5-8 - ASCE; Dredging '02, Orlando, FL.
POC: *conf@asce.org*

May 13-16 - WEFTEC Asia Pacific 2002, Kuala Lumpur, Malaysia.
POC: *weftecasiapacific@wef.org*

Sep 22-26 - PIANC 30th International Navigation Congress, Sydney, Australia

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Articles for *Dredging Research* requested:

Dredging Research is an information exchange bulletin for publication of ERDC-generated dredging research results. Included are articles about applied research projects. The bulletin serves all audiences and is accessible on the World Wide Web in addition to a paper circulation of 2,800.

Articles from non-ERDC authors are solicited for publication, especially if the work described is tied to the use of ERDC-generated research results. Research articles that complement ERDC research or cover wide field applications are also accepted for consideration. Manuscripts should use a nontechnical writing style and should include suggestions for visuals and an author point of contact. Point of contact is Elke Briuer, APR, at *Elke.Briuer@erdc.usace.army.mil.*

This bulletin is published in accordance with AR 25-30 as an information dissemination function of the Environmental Laboratory of the U.S. Army Engineer Research and Development Center. The publication is part of the technology transfer mission of the Dredging Operations Technical Support (DOTS) Program and includes information about various dredging research areas. Special emphasis will be placed on articles relating to application of research results or technology to specific project needs. The contents of this bulletin are not to be used for advertising, publication, or promotional purposes. Citation of trade names does not constitute an official endorsement or the approval of the use of such commercial products. Contributions are solicited from all sources and will be considered for publication. Editor is Elke Briuer, APR, *Elke.Briuer@erdc.usace.army.mil.* Mail correspondence to the Environmental Laboratory, ATTN: DOTS, Dredging Research, U.S. Army Engineer Research and Development Center, Waterways Experiment Station (CEERD-EP-D), 3909 Halls Ferry Road, Vicksburg, MS 39180-6199, or call (601) 634-2349. Internet address: *www.wes.army.mil/el/dots/drieb.html.*

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